J. Environ. Bio., 4(3), 149-153(1983)

THE EFFECT OF CONTROLLED BURNING ON THE EDAPHIC MICROARTHROPOD POPULATION DENSITIES IN A PINE, *PINUS KESIYA* ROYLE PLANTATION.

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(Received : August 30, 1982)
(Accepted : December 23, 1982)

Edaphic microarthropods were collected from the soil-litter sub-systems of both the unburnt and the controlled burnt plots of a pine, *Pinus kesiya* Royle plantation ecosystem. The population densities of different groups of microarthropods such as Collembola, Acarina and Miscellaneous group comprising of Araneidae, Symphylla, Centipedes, Protura and Coleopteran adults and larvae were recorded in many-fold increase in number in unburnt plots compared to the burnt ones. Besides, the gut content was visible in more number of Collembola particularly in *Isotoma* sp. in unburnt plots. It indicated that the burning caused a significant change in the population densities of microarthropods inhabiting the floor of the plantation.

INTRODUCTION

Controlled burning in practical forestry is used to improve the quality of the soil and also to reduce the amount of available fuel (litter on the forest floor) to decrease the risk of accidental ignition and the heat output of the accidental fires. The stimulated effect of this type of burning on soil-litter microarthropods has been studied in different pine plantation/forest ecosystems, such as in *Pinus palusstris* Mill (Heyward and Tissot, 1936), New Jersey pine (Buffington, 1967), *P. pinaster* (Springett, 1971), *P. taeda* L. (Pearse.1943; Metz and Farrier,1973; Dindal and Metz, 1978). However,even though this type of burning is regularly used as one of the silvicultural practices in North Eastern India and many other parts of the subcontinent, little information is available on its effect on different structural parts particularly the consumer and decomposer faunal components of any plantation or forest ecosystem. The present investigation is a preliminary

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TABLE

Comparison of the edaphic microarthropod population densities (1,000 per m²±S. E.) of the burnt and unburnt areas of a pine, *Pinus kesiya* R. Plantation floor.

Different micro-arthropod groups	Before burning April, 1977		After burning May, 1977		June, 1977		July, 1977	
	Burnt	Unburnt	Burnt	Unburnt	Burnt	Unburnt	Burnt	Unburnt
Collembola	25·73	25·47	21·73	186·93	16·67	111·47	31·20	70·93
	±3·01	±3.24	±2·53	±17·19	±6.78	±22·84	±3·86	±6·76
Acarina	49·33	51·07	10·53	18·00	25·47	38·80	3·07	34·27
	±2·66	±2.60	±0·96	±1·62	±4·75	±1·85	±1·16	±3·14
Misc. group	4·67	4·47	2·07	4·93	1·50	5·73	1·33	6·40
	±0·81	±3·35	±0·58	1·27	±0·99	±0·74	±0·74	±0·61
Total micro-arthropods	79·73	80·00	34·94	209·87	46·70	156·00	35·60	111·60

study of the effect of controlled burning on the edaphic microarthropod population densities of a six year old pine, *P. kesiya* Royle plantation ecosystem, located on the side of Gauhati-Shillong road about three kms from Shillong (lat. 25° 34' N and long. 90° 56' E) at an altitude of *ca* 1250 m MSL (North Eastern India). The climate of the area was sub-tropical ever-green rain forest type with an annual temperature range of 6° C in winter to 28° C in summer, and an average rainfall of about 260 cms.

MATERIALS AND METHODS

Two plots each of 100 m^2 size were selected inside the plantation and burnt on 8th April, 1977 according to the silvicultural operations. Two plots adjacent to the burnt ones were left unburnt. Samples consisting of soil-litter, each of size $5 \times 5 \times 10$ cm were taken from each unburnt and burnt portions once before the burning on 5th April, 1977 and thrice after burning, during May, June and July, 1977 and were processed through a set of Tullgren funnels for extraction of microarthropods from the samples. These microarthropods were collected in 80 per cent alcohol, identified and sorted into various major taxonomic groups with the help of a stereoscopic binocular dissecting microscope.

RESULTS AND DISCUSSION

Among all the microarthropods extracted, Collembola followed by Acarina were the two major groups. Others such as Araneidae, Symphylla, Centipedes, Protura and Coleopteran adults and larvae gathered together into a Miscellaneous group. Their population estimates per m^2 on the burnt and unburnt plots of the plantation before and after burning are summarised in Table, a perusal of which reveals that they were more or less equal in number on both the burnt and unburnt plots before burning. These estimates are in corroboration with those of an undisturbed adjacent plantation of the same age (The author's unpublished data). However, the monthly population estimates of May, June and July, 1977 of the unburnt plots, after burning, did not tally with those of the adjacent plantation. In the adjacent plantation the maximum microarthropod population was recorded during July whereas in the unburnt plots adjacent to the burnt ones, the maximum population was recorded during May, 1977 (Table). This was probably due to the migration of the arthropods from the burnt to the unburnt plots because of the unfavourable physico-chemical conditions of the burning. A comparison of population estimates of different groups of microarthropods between the burnt and unburnt plots after the burning indicated a many-fold reduction in number of all three major groups of microarthropods between the burnt plots. The Collembola group in which the *Isotoma* sp. (Isotomidae) was dominant, seemed to be most sensitive, to burning and significantly reduced in number in the burnt plots. In consistent, Huhta *et al.*, (1967) reported that the Collembola suffer more than any other group of edaphic animals by the heat produced by the burning. The reduction in population densities of Acarina (Rice, 1932; Heyward and Tissot, 1936; Pearse, 1943; Buffington, 1967; Huhta *et al.*, 1967 and Metz and Farrier, 1971), Collembola (Heyward and Tissot, 1936; Metz and Farrier, 1973; Metz and Dindal, 1975 and Dindal and Metz, 1978) and Miscellaneous group-Araneidae, Protura, Centipede, Millipede. Coleopteran adults and larvae and Dipteran larvae (Huhta *et al.*, 1967) has also been reported, in the burnt plots. This reduction in population densities of microarthorpods was most probably due to the effect of burning on the micro-climate and other structural conditions of the soil-litter sub-system (Sims, 1976). The litter layer of the burnt area was found completely destroyed due to burning. Moreover, the area which was burnt automatically got an accumulation of charcoal which may have brought about an unsuitable environment for their existance. The reduction in the edaphic fauna in the burnt areas may also be attributable to the loss of organic matter which, in turn, reduced their food supply (Buffington, 1967). Besides, the heat produced by the burning may have killed the bulk of the arthropod populations (Huhta *et al.*, 1967). Metz and Farrier (1973) also reached to similar conclusions that the forest burning totally altered both the abiotic and biotic environments such as moisture, food and protection of the edaphic fauna leading to the reduction in their population densities.

In Collembola particularly in *Isotoma* sp. the gut contents were visible in more animals in the unburnt area than the burnt one. In corroboration, Springett (1971) reported the less number of animals with visible gut content on the burnt areas, which could be attributable to their reduced feeding activity and to the unavailability of food materials. It could also be attributable to the change in the variety of food eaten by them. such as bacterial food which is not easily visible in the gut.

The difference in the microarthropod population densities between the burnt and unburnt plots after one month of burning was found many-fold. However, this difference particularly in Collembola decreased from about eight-fold to about six-fold in July, 1977 (Table). This recovery was probably due to the favourable environmental conditions particularly moisture content which was recorded maximum during July, 1977 in the burnt areas. This confirms the observations of Lussenhop (1976) who recorded little response of soil microarthropods to burning probably because of favourable moisture conditions.

ACKNOWLEDGEMENTS

The author is grateful to Prof. Dr. R. G. Micheal and Prof. Dr. P. S. Ramakrishnan, School of Life Sciences, NEHU, Shillong for providing necessary facilities.

REFERENCES

Buffington, J. D. : Soil arthropod populations of the New Jersey pine barrens as affected by fire. *Ann. Am. Entomol. Soc.*, **60**, 530-535 (1967).

Dindal, D. L. and L. J. Metz : Community structure of Collembola affected by fire frequency. In : The role of arthropods in forest ecosystems. (Ed.) W. J. Mattson, Springer-Verlag, New York, 88-95 (1978).

Heyward. F. and A. H. Tissot : Some changes in soil fauna associated with forest fires in the long leaf pine region. *Ecology*, **17**, 659-666 (1936).

Huhta, V., E. Karppinen, M. Nurminen and A. Valpus : Effect of silvicultural practices upon arthropoda, annelida and nematode populations in coniferous forest soils. *Ann. Zool. Fenn* , 4, 87-143 (1967).

Lussenhop, J. : Soil arthropod response to Prairie burning. *Ecology*, 57, 88-98 (1976).

Metz, L. J. and M. H. Farrier : Prescribed burning and soil mesofauna on the Santee Experimental forest. U. S. Forest Serv., *Southeast. For. Exp. Stn., Prescribed Burning Symp.*, 100-105 (1971).

Metz, L. J. and M. H. Farrier : Prescribed burning and population of soil mesofauna. *Environ. Entomol.*, **2**, 433-440 (1973).

Metz, L. J. and D. L. Dindal : Collembola population and prescribed burning. *Environ. Entomol.*, 4, 583-587 (1975).

Pearse, A. S. : Effects of burning over and raking off litter on certain soil animals in the Duke forest. *Amer. Midl. Natur.*, 29, 406-424 (1943).

Rice, L. : The effect of fire on Prairie animal communities. *Ecology*, **13**, 392-401 (1932).

Sims, H. P. : The effect of prescribed burning on some physical soil properties of jack pine sites in Southern Manitoba. *Can. J. For. Res.*, 6, 58-68 (1976).

Springett, J. A. : The effect of fire on litter decomposition and on soil fauna in a *Pinus pinaster* plantation. *4th Colloquium Pedobiologiae Ann. Zool*, 17, 257-263 (1971).